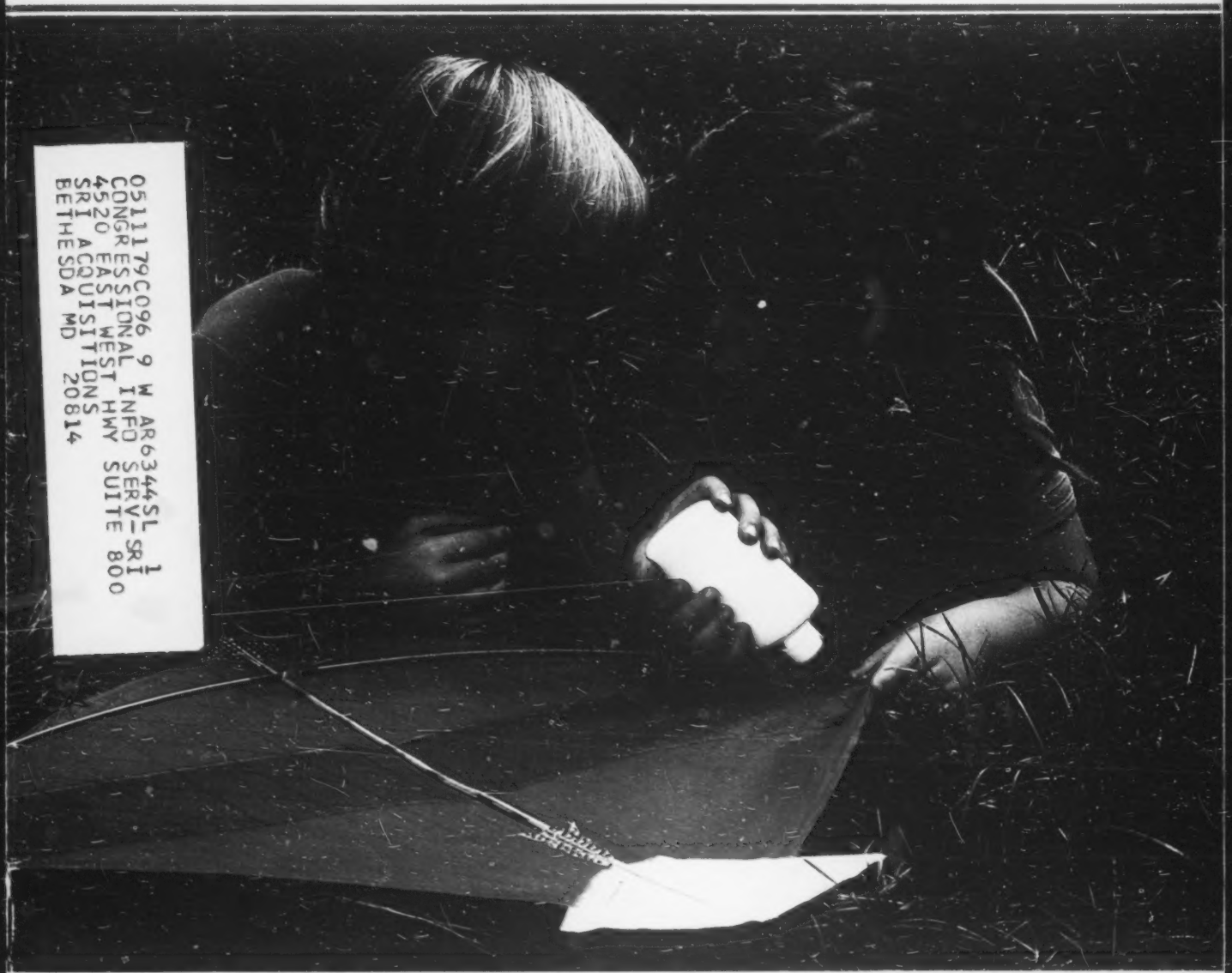
NOVEMBER 4, 1985

CHEMICAL & ENGINEERING

NEWS

Did Kekulé's dream reveal ring structure of benzene?
Page 22



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# ADHESIVE MONOMERS

Little growth forecast for phenol and vinyl acetate

*A Key Chemicals Review Page 11*

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NEWS

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## News of the Week

■ **Monsanto restructuring entails $559 million writedown in fourth-quarter earnings.** **Page 6**

■ **Despite reports of Soviet buildup of chemical and biological arms, House fails to include funds for binary weapons in Defense appropriations bill.** **Page 7**

■ **Chemical information from CAS, other technical databases now available on laser-read compact disks.** **Page 8**

■ **Participants in ILO-sponsored meeting call for an international task force of safety and health experts to help prevent major industrial accidents.** **Page 8**

## Business

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*Cover:* Photo courtesy of Celanese

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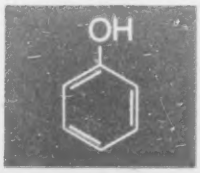
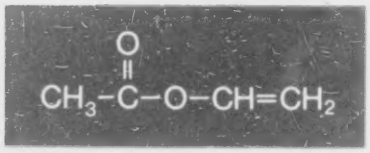



## Cover Story

**Adhesives intermediates phenol and vinyl acetate have few prospects for growth as exports decline and domestic markets mature.** **Page 11**

# Growth Prospects Look Dim for Big-Volume Adhesive Intermediates

**Maturing of most major end uses plus decline in exports makes capacity for phenol and vinyl acetate adequate for rest of 1980s**

**Bruce F. Greek,** C&EN Houston

With the halt of years of hefty growth in demand for phenol and vinyl acetate, producers of these materials have been looking realistically at longer-term demand and need for capacity. These intermediates are of major importance for adhesives and are of significant importance for various coatings, plastics, and fibers, none of which now show much growth.

New developments to expand end uses of adhesives, coatings, plastics, fibers, and other, lesser-volume products have proved to be elusive. As a result, prospects for growth in demand for phenol and vinyl acetate rank no better than the growth in gross national product through the rest of this decade. Such prospects for low growth rates leave producers faced with severe competition, low profitability, and very little reinvestment money.

Bleak as the situation is, overcapacity for phenol and vinyl acetate isn't so bad as it is for some major-volume organic chemicals. With operating rates for these adhesive materials in the 75 to 85% range, there are no problems in meeting demand, unless raw materials become short. If demand growth falls between 1 and 3% annually on the average over the next five years, present capacity will be large enough to satisfy demand for the next several years.

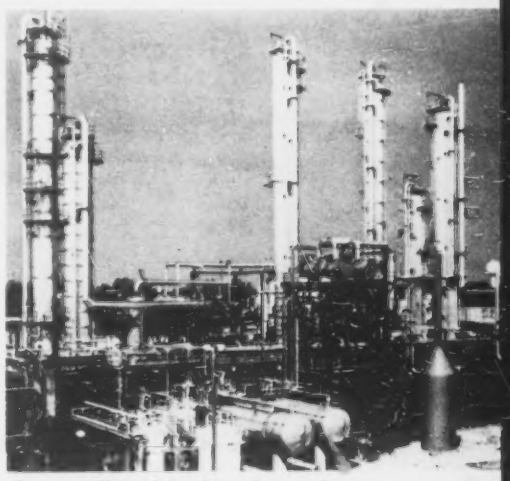
## Key Chemicals

A close examination of the situation for both these compounds reveals various differences, but the same conclusion remains—that sufficient capacity now exists to meet demand through 1990. Phenol production in 1985 will require an average operating rate of 75%. Even growth at 3% compounded for the next five years will not use up all of present capacity available for operation. Some phenol capacity, however, is quite old and may be scrapped because of its inefficiencies. Some recently announced expansions could partially or totally replace that scrappage.

For vinyl acetate, the outlook hinges more on export markets. Exports, which once accounted for more than a quarter of production, long have been forecast to decline, and those forecasts have been reliable until this year. The decline in exports has offset the gains in U.S. consumption of vinyl acetate, thereby holding production relatively constant. In the future, after the minor anomaly of a possible slight rise in exports in 1985, more declines are forecast as new capacity to make vinyl acetate comes on stream in various countries that now are large buyers of U.S. product. Some of these new and expansive producers could become exporters on their own, which might further reduce U.S. exports to countries that are without vinyl acetate plants.

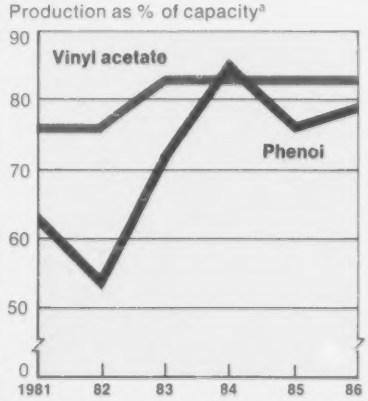
Imports of phenol and vinyl acetate are so small they have a negligible effect on U.S. markets, and they are forecast to remain small. Producers of these materials will focus more on domestic consumption—in view of declining exports. They then can assume GNP growth rates for the major mature end-use expansion and conclude that capacity for phenol and vinyl acetate will be adequate for longer than ever before.

For some details of the near-term outlook for phenol and vinyl acetate, please see the following pages.



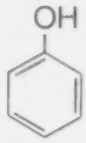
*General Electric's phenol complex in Mount Vernon, Ind.*

**Since recession, plant capacity use has stabilized**



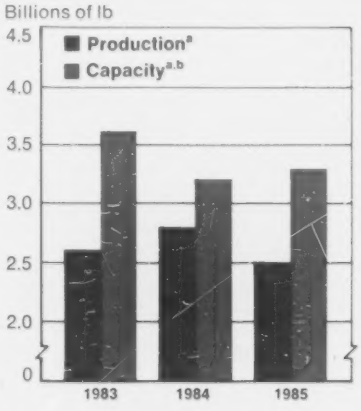

a First-quarter nameplate capacity. **Sources:** International Trade Commission, C&EN estimates

# Phenol




- **Demand slowing**
- **Capacity may rise**
- **Prices unsettled**

## PRODUCTION/CAPACITY




a Synthetic only. b First quarter

## MAJOR PRODUCERS

*Allied-Signal, Dow Chemical, General Electric, Shell Chemical, USS Chemicals*

## HOW MADE

*Peroxidation of cumene (isopropyl benzene) and cleavage to phenol and acetone*

## MAJOR DERIVATIVES (U.S.)

*Resins (mostly with formaldehyde as comonomer) 40%, bisphenol A 20%, caprolactam 15%*

## MAJOR END USES (U.S.)

*Adhesives 60%, plastics 20%*

## FOREIGN TRADE

*Exports—holding at about 100 million lb, imports—rising to about 50 million lb*

## PRICE

*About 34 cents a lb, freight-equalized*

This year is a relatively poor one for phenol producers. Production will be down slightly, but profitability is falling severely. None of phenol's major end uses will grow very much in 1985, with a slowdown in construction accounting for most of the decline.

Synthetic phenol production in the U.S. will total about 2.5 billion lb this year, or possibly 2.6 billion lb if plywood producers anticipate improved demand for their product from an increase in housing starts in 1986.

Capacity to make phenol totals about 3.3 billion lb. That total includes world-scale plants with nameplate capacities of more than 500 million lb a year and small plants with capacities of less than 100 million lb a year. Moreover, several very small units operate to recover phenol from natural sources such as coal tar and petroleum fractions. These small units have a combined capacity of 50 million lb a year.

Capacity expansions for synthetic phenol production have been minor over the past year or more. No more than 100 million lb has been added to the total. As a result, plants will run at about 75% of capacity.

As usual, with an average operating rate of 75%, rumors have developed about possible plant shutdowns. The smaller plants always are the obvious candidates for scrappage, especially if they are old. However, many of the smaller units have some load from captive demand to make resins, similar to plants that produce natural phenol. Economics favor keeping such plants running, if marginal output can be sold on the merchant market.

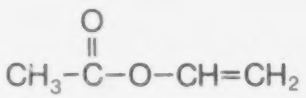
The efforts to keep production up cause the major woe of the phenol business—low selling prices. Besides competitive pressures stemming from excess production, phenol producers also face pressure from buyers who expect lower prices as a result of a decline in benzene prices. Current benzene list prices are down about 10%, or about 15 cents per gal, from the recent highs. This decline in benzene prices puts about a 2 cent-per-lb price pressure on phenol alone.

Consumption in making phenolic resins, mostly condensation polymers from the reaction of phenol and formaldehyde, is critical to phenol pricing and demand. These resins account for nearly 40% of phenol consumption in the U.S. About 85% of such resins are used as adhesives or binders, slightly more than half of which are used in making plywood and wood fiberboard. Therefore, construction effectively controls phenol demand.

The outlook for such construction now appears to be flat to slightly down. Recent monthly housing starts have declined, but so have interest rates for mortgages. Some industry sources expect that lower interest rates will increase housing starts in 1986, but others expect interest rates to rise because of the federal deficit. Plywood makers are warily watching their own inventories and the stocks further down the consumption chain toward construction in combination with interest rates. Apparently, some plywood inventory liquidation occurred earlier in 1985, reducing phenol demand for a time. Several phenol producers believe that inventories are relatively low in relation to current housing construction, so demand could increase in early 1986 if the housing market turns up.

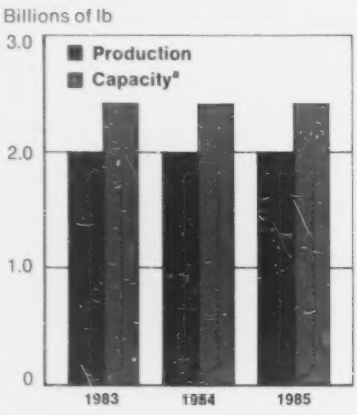
Other uses of phenol, such as in making bisphenol A and caprolactam, will grow faster than will phenol-formaldehyde resins. Most bisphenol A goes into epoxy and polycarbonate resins, both of which continue to grow well. Caprolactam made from phenol goes mostly into making nylon 6, then into carpet fibers where demand remains fairly strong but heavily dependent on housing. Several miscellaneous uses of phenol take the remaining production. They range from making aniline that goes into polyurethanes to making 2,6-xylenol that becomes polyphenylene oxide plastics. None are very large, and none are growing fast enough to influence total demand.

# Vinyl acetate



- ***Demand steady***
- ***Capacity on hold***
- ***Prices slightly better***

PRODUCTION/CAPACITY




a First quarter.

MAJOR PRODUCERS

*Celanese, Du Pont, Union Carbide, U.S. Industrial Chemicals*

HOW MADE

*Vapor-phase reaction of ethylene, acetic acid, and oxygen*

MAJOR DERIVATIVES (U.S.)

*Polymers 55%, polyvinyl alcohol 20%, copolymers 15%*

MAJOR END USES (U.S.)

*Adhesives 40%, paints 25%, paper and textile coatings 20%*

FOREIGN TRADE

*Exports—more than 500 million lb, imports—small, about 1 million lb*

PRICE

*37 to 39 cents a lb, delivered*

Production of vinyl acetate remains stagnant. Until 1985, however, U.S. consumption had been rising, but declining exports offset the increased consumption, holding production at about 2 billion lb for three years in a row.

In early 1985, exports had been increasing, suggesting that total production this year might rise above the 2 billion lb level. But as exports increased, domestic consumption began to drop in large-volume end uses such as paints and textile sizings. More recently, exports have been reported lower, suggesting that exports for the year will be close to 500 million lb, about the same as last year. Exports of vinyl acetate derivatives usually have added another 100 million lb or so.

No significant vinyl acetate capacity additions have been made in the past year. The capacity has been holding for the past four years and will hold through 1986 at 2.4 billion lb. The reason for lack of expansion remains obvious: absence of growth in demand for vinyl acetate and existing overcapacity. If production in 1985 totals 2 billion lb, then the plant operating rate will be 83% of capacity.

Almost all vinyl acetate eventually becomes some kind of polymer, of itself, with another monomer such as ethylene or vinyl chloride, or becomes polyvinyl alcohol, which is a derivative of polyvinyl acetate.

The largest-volume end use of vinyl acetate continues to be adhesives, accounting for about 40% of U.S. consumption. Major end uses are in packaging, construction, and consumer products. The packaging uses are dominated by corrugated paperboard, laminates, labels, and tapes. Construction uses are somewhat limited by strength properties, but major end uses include such items as wallboard tapes, laminates of polyvinyl chloride as coverings to gypsum board for prefinished panels, and direct adhesives. The consumer adhesive area includes glues for paper, wood, and plastics.

Many of the adhesive uses relate to the economy, so growth has a direct relationship to gross national product. Use in construction relates closely to housing, which has been having an unspectacular year with prospects for the first half of 1986 about the same, depending on interest rates.

Paints, which make up about a third of U.S. consumption of vinyl acetate, also are almost completely copolymers, most often made with various acrylates. Housing again dominates this use, but housing starts are not so great an influence on paint sales as they are on demand for other chemical products. This is because trade sales of paint for repainting houses reflect decisions other than just new housing. Even in times when new housing sales are down, paint trade sales, especially interior paints, hold up well. Vinyl acetate, plus 10 to 20% comonomers, has almost completely replaced alkyd resins in interior paints. Growth in use of vinyl acetate in semigloss trim paints for interior use and in exterior paints continues to be slower than the takeover of interior wall paints, but developments of polymers with a third comonomer to help weathering and stability to ultraviolet light will help vinyl acetate in exterior paints.

Because of the quality improvements and the trend toward smaller houses and living spaces, however, paint sales are expected to rise no faster than the GNP. Consequently, vinyl acetate demand growth in paints will range from zero to the same rate as the GNP.

Vinyl acetate for paper and textile coatings also is consumed as polymers, usually as a homopolymer, as a copolymer with minor quantities of a comonomer, or as polyvinyl alcohol. As might be expected from the high imports of apparel, textile coatings (sizings) as a use of vinyl acetate are down.

Paper coatings are growing well, however, because of efforts to improve quality of such products as printing papers, labels, and boxboard.